

*IN THE UNITED STATES PATENT AND TRADEMARK OFFICE*

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In re Patent Application of:  
GEE NEOH, et al.

Application No.: 09/895,153

Confirmation No.: 9536

Filed: July 2, 2001

Art Unit: 1762

For: PHOTOINDUCED CONVERSION OF  
POLYANILINE FROM AN INSULATING  
STATE TO A CONDUCTING STATE

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Examiner: Elena TSOY

**SUBSTITUTE BRIEF ON APPEAL**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

This is an appeal from the Final Rejection of claim 36.

*(i.) Real party in interest.*

The real party in interest in this appeal is the Assignee of the involved patent application, National University of Singapore.

*(ii.) Related appeals and interferences.*

There are no related appeals or interferences.

*(iii.) Status of claims.*

Claims 39 and 41-52 are allowed. Claims 1-35, 37, 38, and 40 have been cancelled. Claim 36 stands rejected. The rejection of claim 36 is being appealed.

*(iv.) Status of Amendments.*

No Amendments were filed subsequent to the mailing of the Final Rejection. On March 3, 2006, Applicants filed a Request for Reconsideration, which was accompanied by evidentiary publications. The Examiner considered the Request for Reconsideration, expressing her opinion in an Advisory Action mailed on March 13, 2006.

*vi.) Summary of claimed subject matter.*

The claim on appeal reads as follows: "A method for preparing an electrically conductive polymeric material comprising: a) providing a vinyl benzyl halide grafted film substrate; b) reacting the vinyl benzyl halide grafted film with an equimolar mixture of 4,4' bipyridine and p-xylene dihalide to form a viologen salt-grafted film; c) coating the viologen salt-grafted film with polyaniline to form a polyaniline-coated film; and d) exposing the polyaniline-coated film to near-ultraviolet radiation to obtain an electrically conductive polymer."

The method for preparing the electrically conductive polymeric material at issue in this appeal includes four sequential steps. One step involves providing a vinyl benzyl halide grafted film substrate. Specification, e.g. page 11, lines 20-22. One step involves reacting the vinyl benzyl halide grafted film with an equimolar mixture of 4,4' bipyridine and p-xylene dihalide to

form a viologen salt-grafted film. Specification, e.g. page 11, lines 22-27. “Viologen” salts are 4,4'-bipyridylium salts. One step involves coating the viologen salt-grafted film with polyaniline to form a polyaniline-coated film. Specification, e.g. page 11, line 27 – page 12, line 2. One step involves exposing the polyaniline-coated film to near-ultraviolet radiation to obtain an electrically conductive polymer. Specification, e.g. page 12, lines 2-5.

In order to enhance this explanation of the subject matter covered by claim 36, Applicants point out that polyaniline in its insulating (free base) form can be cast into films and coated on substrates. Specification, page 1, lines 13-15. The insulating form of polyaniline can be converted to a conductive form by treatment with aqueous protonic acids or by charge transfer interaction with organic electron acceptors. Specification, page 1, line 15 – page 2, line 24. The degree of electrical conductivity of the converted polyaniline is dependent upon the oxidation state of the polyaniline. Specification, page 2, lines 1-5 and 17-24.

The present invention provides electrically conductive polymeric material having resistances decreasing from  $10^{10}$  to  $10^5 \Omega/\text{sq}$ , irrespective of the oxidation state of the polymeric material. Specification, page 4, lines 2-9.

*(vi.) Grounds of rejection to be reviewed on appeal.*

The sole issue precluding allowance of the present application is the rejection of claim 36 under 35 U.S.C. § 103(a) as being unpatentable over the combination of JP 56-26977 (Sato), US 4,455,233 (Pohl), US 4,414,080, (Williams), and US 5,016,063 (Beratan).

(viii.) *Argument*

Applicants submit that the Examiner is improperly using hindsight to assemble individual, unrelated teachings of the references, using the rejected claim as a template. Furthermore, even when combined, the collection of references cited by the Examiner fails to disclose or suggest a significant feature of the invention. Thus, the Examiner has not established a proper case of *prima facie* obviousness of the invention.

In the rejection of record, the references outnumber the sole claim under consideration 4 to 1. While there is no absolute prohibition against references “ganging up” on a claim in this manner, the chances that a person of ordinary skill in the art would really have been motivated to assemble this motley<sup>1</sup> grouping of references to come up with Applicants’ technology *in the absence of Applicants’ disclosure* is minimal.

The Final Rejection relies upon the statement of the rejection in the Office Action that was mailed on July 5, 2005. After summarizing the relevant teachings of the Sato reference, the Examiner states:

Sato et al fails to teach that (i) benzyl chloride groups can be grafted on a polymeric substrate other than phenyl-containing substrate using vinyl benzyl chloride instead of CH<sub>3</sub>OCH<sub>2</sub>Cl; (ii) an equimolar mixture of 4,4’ bipyridine and p-xylene dihalide is used instead of 4,4’ bi pyridyl mono aralkyl halide compound; (iii) instead of polyvinyl alcohol, polyaniline can be used as electron donor for coating the viologen salt layer.

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<sup>1</sup> Sato is entitled “Photochromic compositions containing viologen compound blended with solid alcohol” and is assigned to Nippon T & T. Sato relates to photosensitive film technology similar to that of the present invention. Pohl is entitled “Method and apparatus for ion analysis and detection using reverse mode suppression” and is assigned to Dionex Corp. Pohl is concerned with the separation of ions by liquid chromatography. Williams is entitled “Photoelectrochemical electrodes” and is assigned to NASA. Williams relates to photoelectrochemical electrodes. Beratan is entitled “Molecular Implementation of molecular shift register memories” and is also assigned to NASA. Beratan describes a molecular shift register employing an electron transfer mechanism.

Office Action mailed 07/05/2005, page 3. This summary of major differences between what is claimed herein and what is taught in the closest prior art reference is more reminiscent of an Examiner's Statement of Reasons for Allowance than a rejection. Unfortunately, however, the Examiner here appears to have raked through the patent literature to find individual references that allegedly remedy the deficiencies of the Sato reference.

Sato teaches that his films are homogeneous and slightly yellowish in color. His films develop a bright bluish violet color when irradiated, and then de-color upon heating or standing.

POHL IMPROPERLY COMBINED. To remedy one deficiency of the Sato reference, the Examiner cites lines 3-15 in column 8 of Pohl. The cited portion of Pohl teaches grafting vinyl benzyl chloride onto polyethylene tubing "to render it suitable for conversion to ion-exchange form. Thereafter, the grafted tubing is aminated as set forth in [a] U.S. patent application entitled 'Method And Apparatus For Mobile Phase Ion Chromatography And Membrane Suppression'." The Examiner fails to indicate why a person of ordinary skill in the photochromic film art would look to the ion exchange chromatography art for ways to change the Sato photochromic technology. Even more significantly, the Examiner fails to indicate why one of ordinary skill in the art would be motivated to "irradiat[e] a polyethylene substrate in a solution of vinyl benzyl chloride instead of chloromethylating polystyrene using  $\text{CH}_3\text{OCH}_2\text{Cl}$ ". Office Action of July 5, 2005, page 4. Simply pointing out that something *could* be done does not make it obvious to do it. "The mere combination of prior art references does not make an invention obvious unless something in the prior art suggests or reasonably implies an *advantage*

*to be derived* from uniting their teachings.” *Creative Pioneer Products Corp. v. K-Mart Corp.*, 5 USPQ2d 1841, 1844 (S.D. Tex 1986) (emphasis supplied).

BERATAN IMPROPERLY CONSTRUED. In their response filed October 13, 2005, in the paragraph bridging pages 8-9 thereof, Applicants explained that:

The Examiner states that Beratan discloses that polyaniline is a suitable electron donor for a viologen salt acceptor. Beratan does not make any conductive material comprising polyaniline. Beratan shows redox cycling between aniline and viologen monomer units in a polymer using a ruthenium bipyridine intermediate. *See*, col. 6, lines 18-22. Such a composition is far afield from one comprising a viologen salt and polyaniline as distinct substances.

Thus, Beratan in fact describes a material that is a co-polymer of aniline and viologen, not an article comprising polyaniline and viologen. Accordingly, the combined references in fact make no suggestion of irradiation of an article comprising polyaniline and viologen to obtain a conductive material. The Examiner has still failed to respond to this point (originally raised in the October 13, 2005 Amendment), either in the Final Rejection or in the Advisory Action.

FAULTY UNDERSTANDING OF MECHANISM. The Examiner has stated that “[P]hotoreduction of a viologen salt by polyaniline occurs by electron transfer when irradiated ...due to electroconductivity...”. Final Rejection, page 5 (emphasis in original). This statement highlights the Examiner’s misunderstanding of the present invention. Electron transfer is the mechanism of an oxidation-reduction reaction. Electron transfer does **not** imply conduction, *i.e.* movement of electrons through a material under the influence of a voltage gradient.

As evidence of this distinction, Applicants have provided publications by Kamogawa et al., Sampanthar et al., and Ogawa et al. Kamogawa et al. show the exchange of an electron

between a viologen molecule and a halide ion. See, e.g. the reaction scheme below Figure 2 on page 1022. The negatively charged halide ion is converted to a neutral halogen atom, and the positively charged tertiary amine of the viologen is also rendered neutral, with the result that the viologen absorption spectrum changes and the viologen becomes colored. This is a classic example of an oxidation-reduction reaction and also of photochromism as described by Sato. Sampanthar et al. show essentially the same reaction in the instance of viologen grafted to a low density polyethylene substrate. Further information of how poly(vinyl alcohol) (PVA) participates in the photoreduction of viologen is seen in Ogawa et al., which describes the change in color of methyl viologen when it is reduced by absorption of an electron generated by oxidation of PVA by gamma radiation or electron beam radiation (as a model of beta rays). Like the Sato reference, Ogawa et al. do not provide any evidence that any electrical conductivity is achieved. In fact, it is highly unlikely, if not impossible for PVA, a non-conjugated polymer, to allow the transport of electrons along its chains. It is certainly not the case that whenever a substance undergoes oxidation, it becomes electrically conductive. It should be noted that all of Sato, Kamogawa, Sampanthar, and Ogawa suggest that the electrons transferred remain localized. There is no suggestion whatsoever that any material is formed that would provide for electron flow under an imposed voltage gradient, i.e. that a conductive material would be made.

The Examiner argues that it does not matter whether she is right or wrong with respect to whether electron transfer is the same as electroconductivity. She maintains that, regardless of mechanism, the polymeric material of the references would *inherently have the same properties* as the polymeric material produced in the invention of claim 36. It is true that inherency can bar

a patent under U.S. law, but this should be inherency in a composition actually disclosed in the prior art, not alleged inherency of a composition that could theoretically be produced by modifying the prior art. The Examiner cites sections 2111.02 and 2112.01 of the Manual of Patent Examining Procedure (MPEP). It is not clear why she cites MPEP 2111.02, which is entitled "Effect of Preamble". MPEP 2112.01 does discuss inherency, but the context of the discussion indicates that inherency is a consideration where a claim is rejected over a single reference, not over a combination of references.

SUMMARY. Applicants respectfully submit that the cited references fail to establish *prima facie* obviousness of the claimed invention. In particular, there is no teaching or suggestion by the combined references that a conductive polymer can be obtained by irradiation of polyaniline-coated viologen. This feature of the invention is totally lacking from the combined teachings of the references.

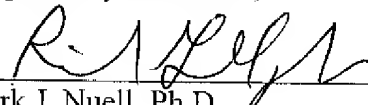
For at least the reasons explained above, the combination of Sato JP '977, Pohl '233, Williams et al. '080, and Beratan '063 fail to expressly describe or to suggest the subject matter of claim 36. Accordingly, the rejection of claim 36 under 35 U.S.C. § 103(a) over these references is improper as stated by the Examiner and should be reversed.



If there are any questions concerning the present application, the Examiner is respectfully requested to contact Richard Gallagher (Reg. No. 28,781) at (703) 205-8008.

Dated: December 29, 2006

Respectfully submitted,

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***(viii.) Claims Appendix:***

The sole claim rejected is claim 36:

36. A method for preparing an electrically conductive polymeric material comprising:
- a) providing a vinyl benzyl halide grafted film substrate;
  - b) reacting the vinyl benzyl halide grafted film with an equimolar mixture of 4,4' bipyridine and p-xylene dihalide to form a viologen salt-grafted film;
  - c) coating the viologen salt-grafted film with polyaniline to form a polyaniline-coated film; and
  - d) exposing the polyaniline-coated film to near-ultraviolet radiation to obtain an electrically conductive polymer.

***(ix.) Evidence Appendix:***

- Ogawa et al., *Radiat. Phys. Chem.*, Vol. 29, No. 5, 353-357 (1987), part of response filed October 13, 2005.
- Kamogawa et al., *Chem. Mater.*, 1991, 3, 1020-1023, part of response filed March 3, 2006.
- Sampanthar et al., *Advanced Materials*, 2000, 12, 1536-1539, part of response filed March 3, 2006.

***(x.) Related proceedings Appendix:***

There are no related proceedings.